

CLAIMS

1. A photocatalyst composition comprising:

(A) modified photocatalyst particles,

5 said modified photocatalyst particles (A) being prepared by subjecting particles of a photocatalyst (a) to a modification treatment with at least one modifier compound (b) selected from the group consisting of different compounds each of which independently comprises
10 at least one structural unit selected from the group consisting of a triorganosilane unit represented by formula (1), a monooxydiorganosilane unit represented by formula (2), and a dioxyorganosilane unit represented by formula (3):

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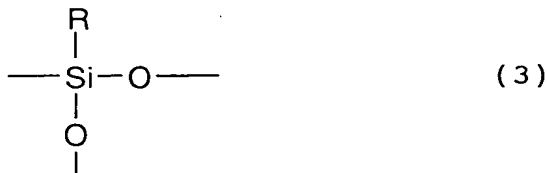
wherein each R independently represents a straight chain or branched C₁-C₃₀ alkyl group, a C₅-C₂₀ cycloalkyl group, a straight chain or
20 branched C₁-C₃₀ fluoroalkyl group, a straight chain or branched C₂-C₃₀ alkenyl group, a phenyl group, a C₁-C₂₀ alkoxy group or a hydroxy group,

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wherein each R is as defined for formula (1), and

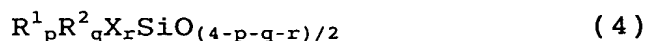
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wherein R is as defined for formula (1), and

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(B) a binder component which comprises a phenyl group-containing silicone (BP), optionally containing an alkyl group, represented by formula (4):



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wherein:

the or each R^1 represents a phenyl group, and the or each R^2 independently represents a straight chain or branched C_1 - C_{30} alkyl group, a C_5 - C_{20} cycloalkyl group or a straight chain or branched C_2 - C_{30} alkenyl group;

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the or each X independently represents a hydrogen atom, a hydroxyl group, a C_1 - C_{20} alkoxy group, a C_1 - C_{20} acyloxy group, an aminoxy group, a C_1 - C_{20} oxime group or a halogen atom;

25

and

p, q and r satisfy the following relationships:

$$0 < p < 4,$$

$$0 \leq q < 4,$$

$$0 \leq r < 4,$$

$$0 < (p + q + r) < 4, \text{ and}$$

$$0.05 \leq p / (p + q) \leq 1.$$

2. The composition according to claim 1, wherein the or each R of each of formulae (1) to (3) independently represents a straight chain or branched C₁-C₃₀ alkyl group, a C₅-C₂₀ cycloalkyl group, a straight chain or branched C₁-C₃₀ fluoroalkyl group, a straight chain or branched C₂-C₃₀ alkenyl group or a C₁-C₂₀ alkoxy group.

3. The composition according to claim 1 or 2, wherein said phenyl group-containing silicone (BP) is a phenyl group-containing silicone (BP1), containing no alkyl group, represented by formula (5):



wherein:

the or each R¹ represents a phenyl group;

the or each X independently represents a hydrogen atom, a hydroxyl group, a C₁-C₂₀ alkoxy group, a C₁-C₂₀ acyloxy group, an aminoxy group, a C₁-C₂₀ oxime group or a halogen atom;
 5 and

s and t satisfy the following relationships:

$$0 < s < 4,$$

$$0 \leq t < 4, \text{ and}$$

$$0 < (s + t) < 4.$$

10 4. The composition according to claim 1 or 2, wherein said binder component (B) further comprises an alkyl group-containing silicone (BA) represented by formula (6):



wherein:

the or each R² independently represents a
 20 straight chain or branched C₁-C₃₀ alkyl group,
 a C₅-C₂₀ cycloalkyl group or a straight chain
 or branched C₂-C₃₀ alkenyl group;

the or each X independently represents a hydrogen atom, a hydroxyl group, a C₁-C₂₀ alkoxy
 25 group, a C₁-C₂₀ acyloxy group, an aminoxy

group, a C₁-C₂₀ oxime group or a halogen atom;
and

u and v satisfy the following relationships:

$$0 < u < 4,$$

$$0 \leq v < 4, \text{ and}$$

$$0 < (u + v) < 4.$$

5. The composition according to claim 1, 2 or 4,
wherein said binder component (B) comprises a phenyl
group-containing silicone (BP1), containing no alkyl
group, represented by formula (5):



wherein:

the or each R¹ represents a phenyl group;

the or each X independently represents a hydrogen atom, a hydroxyl group, a C₁-C₂₀ alkoxy group, a C₁-C₂₀ acyloxy group, an aminoxy

group, a C₁-C₂₀ oxime group or a halogen atom;
and

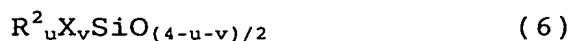
s and t satisfy the following relationships:

$$0 < s < 4,$$

$$0 \leq t < 4, \text{ and}$$

$$0 < (s + t) < 4; \text{ and}$$

an alkyl group-containing silicone (BA) represented by formula (6):



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wherein:

the or each R^2 independently represents a straight chain or branched C_1 - C_{30} alkyl group, a C_5 - C_{20} cycloalkyl group or a straight chain or branched C_2 - C_{30} alkenyl group;

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the or each X independently represents a hydrogen atom, a hydroxyl group, a C_1 - C_{20} alkoxy group, a C_1 - C_{20} acyloxy group, an aminoxy group, a C_1 - C_{20} oxime group or a halogen atom;

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and

u and v satisfy the following relationships:

$$0 < u < 4,$$

$$0 \leq v < 4, \text{ and}$$

$$0 < (u + v) < 4.$$

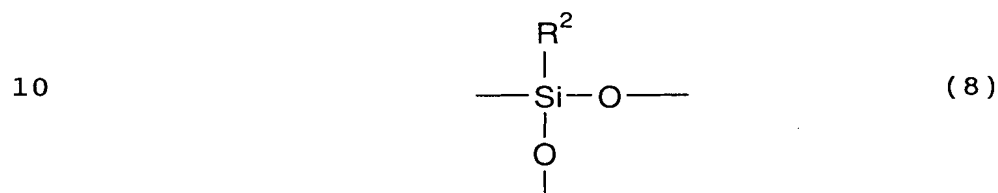
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6. The composition according to claim 4 or 5, wherein said alkyl group-containing silicone (BA) comprises a monooxydiorganosilane unit (D) represented by formula (7) and a dioxyorganosilane unit (T) represented by formula (8):

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wherein each R^2 independently represents a
 5 straight chain or branched C_1 - C_{30} alkyl group,
 a C_5 - C_{20} cycloalkyl group or a straight chain
 or branched C_2 - C_{30} alkenyl group, and



wherein R^2 is as defined for formula (7).

15 7. The composition according to claim 3 or 5, wherein
 said phenyl group-containing silicone (BP1) has a
 weight average molecular weight of from 500 to 10,000,
 as measured by gel permeation chromatography using a
 calibration curve obtained with respect to standard
 20 polystyrenes.

8. The composition according to claim 4 or 5, wherein
 said alkyl group-containing silicone (BA) has a weight
 average molecular weight of from 500 to 10,000, as
 25 measured by gel permeation chromatography using a cali-

bration curve obtained with respect to standard polystyrenes.

9. The composition according to any one of claims 1 to 8, wherein said modified photocatalyst particles (A) have a number average particle diameter of 400 nm or less.

10. The composition according to any one of claims 1 to 9, wherein said photocatalyst particles (a) are titanium oxide particles.

11. The composition according to any one of claims 1 to 10, wherein said modifier compound (b) is an Si-H group-containing silicon compound (b1) represented by formula (9):



20 wherein:

the or each R independently represents a straight chain or branched $\text{C}_1\text{-C}_{30}$ alkyl group, a $\text{C}_5\text{-C}_{20}$ cycloalkyl group, a straight chain or branched $\text{C}_1\text{-C}_{30}$ fluoroalkyl group, a straight chain or branched $\text{C}_2\text{-C}_{30}$ alkenyl group, a

phenyl group, a C₁-C₂₀ alkoxy group or a hydroxy group, and

x and y satisfy the following relationships:

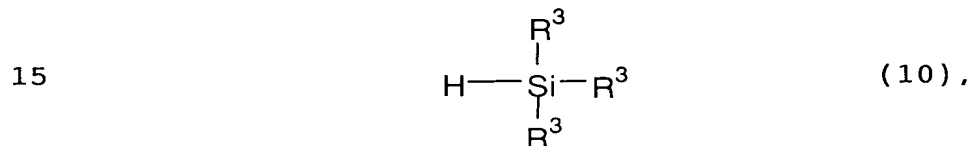
$$0 < x < 4,$$

$$0 < y < 4, \text{ and}$$

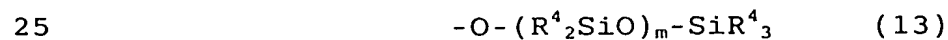
$$(x + y) \leq 4.$$

12. The composition according to claim 11, wherein said Si-H group-containing silicon compound (b1) comprises at least one compound selected from the group consisting of:

a mono Si-H group-containing silicon compound represented by formula (10):

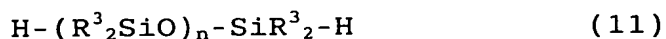


wherein each R³ independently represents a straight chain or branched C₁-C₃₀ alkyl group, a straight chain or branched C₂-C₃₀ alkenyl group, a C₅-C₂₀ cycloalkyl group, a straight chain or branched C₁-C₃₀ fluoroalkyl group, a phenyl group or a siloxy group represented by formula (13):

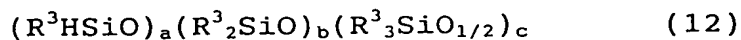


wherein each R^4 independently represents a straight chain or branched C_1 - C_{30} alkyl group, a C_5 - C_{20} cycloalkyl group, a straight chain or branched C_1 - C_{30} fluoroalkyl group, a straight chain or branched C_2 - C_{30} alkenyl group or a phenyl group; and m is an integer which satisfies the formula: $0 \leq m \leq 1000$,

a silicon compound, having Si-H groups at both terminals thereof, represented by formula (11):



wherein R^3 is as defined for formula (10); and n is an integer which satisfies the formula: $0 \leq n \leq 1000$, and an H silicone represented by formula (12):



wherein:

R^3 is as defined for formula (10); and a is an integer of 1 or more, b is an integer of 0 or more, and a and b satisfy the following relationship: $(a + b) \leq 10000$, and c is 0 or 2, and

wherein when $(a + b)$ is an integer of 2 or more and $c = 0$, said H silicone of formula (12) is a cyclic silicone, and when $c = 2$, said H silicone of formula (12) is a straight chain silicone.

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13. The composition according to any one of claims 1 to 12, which further comprises a resin.

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14. The composition according to any one of claims 1 to 13, which is a film.

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15. The composition according to claim 14, which is anisotropic with respect to the distribution of the modified photocatalyst particles (A), wherein the concentration of the modified photocatalyst particles (A) increases from one surface of the film toward the other surface of the film.

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16. The composition according to any one of claims 1 to 13, which is a shaped article.

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17. The composition according to claim 16, which is anisotropic with respect to the distribution of the modified photocatalyst particles (A), wherein the concentration of the modified photocatalyst particles (A)

increases from the inner portion of the shaped article toward the surface of the shaped article.

5 18. The composition according to claim 4, which is a film which has a microphase separation structure with respect to said phenyl group-containing silicone (BP) and said alkyl group-containing silicone (BA).

10 19. The composition according to claim 18, which is anisotropic with respect to the distribution of the modified photocatalyst particles (A), wherein the concentration of the modified photocatalyst particles (A) increases from one surface of the film toward the other surface of the film.

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20. The composition according to claim 4, which is a shaped article which has a microphase separation structure with respect to said phenyl group-containing silicone (BP) and said alkyl group-containing silicone (BA).

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21. The composition according to claim 20, which is anisotropic with respect to the distribution of the modified photocatalyst particles (A), wherein the concentration of the modified photocatalyst particles (A) increases from the inner portion of the shaped article

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toward the surface of the shaped article.

22. A functional composite comprising a substrate and a film formed on said substrate, said film comprising
5 the composition of any one of claims 1 to 13.

23. The functional composite according to claim 22, wherein said film is anisotropic with respect to the distribution of the modified photocatalyst particles
10 (A), wherein the concentration of the modified photocatalyst particles (A) increases from a surface of the film which contacts the substrate toward the other, exposed surface of the film.

15 24. A functional composite comprising a substrate and a film formed on said substrate, said film comprising the composition of claim 4 and having a microphase separation structure with respect to said phenyl group-containing silicone (BP) and said alkyl group-
20 containing silicone (BA).

25 25. The functional composite according to claim 24, wherein said film is anisotropic with respect to the distribution of the modified photocatalyst particles (A), wherein the concentration of the modified photo-

catalyst particles (A) increases from a surface of the film which contacts the substrate toward the other, exposed surface of the film.